



# RAINWATER COLLECTION GUIDELINES

FOR MILWAUKEE RESIDENTS & PROPERTY OWNERS

CITY OF MILWAUKEE, ENVIRONMENTAL COLLABORATION OFFICE

UWM SCHOOL OF FRESHWATER SCIENCES

## INTRODUCTION

During a rainstorm, have you ever wondered whether the water running off the roof and down the driveway can be used? Today many homeowners have seriously examined a practice begun many centuries ago. Rainwater harvesting has been in use since the Romans first developed systems for rainwater collection. But it is a relatively new practice for urban environments like Milwaukee due to the public supply of potable water available from a local utility at a relatively low cost.

That is not the case in many areas of the world or even the arid locations in the United States, where most of the municipal water comes from overstressed underground aquifers. As the saying goes, “You don’t know the value of water until the well is running dry.”

Rainwater harvesting is an excellent way to reduce the amount of potable water your household or property consumes. This practice can also help reduce your water utility bill and reduce the amount of storm water entering Milwaukee’s combined sewers. In addition, it provides a great benefit to the local rivers, streams and even Lake Michigan by reducing the amount of contaminated water entering the waterways.

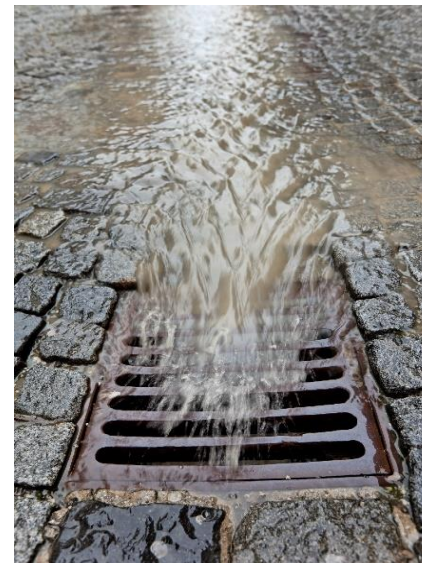
For a homeowner, one might think that rainwater harvesting is as easy as: 1. Buying a barrel, 2. Placing the barrel, 3. Filling that barrel

with rain, and then 4. Using that water from the barrel after it rains. But as with most things, it’s not really that simple.

This review of guidelines and local regulations, along with a residential case study will provide the homeowner with some direction as to how to plan for, install, and use a small-scale rainwater harvesting system. This document provides some additional Pro Tips that will make your system even better.

## RAIN WATER HARVESTING

Rainwater harvesting (RWH) is the collection of free water in the form of precipitation, the storage of that water in a container and the use of it for both potable and non-potable benefits.



In Wisconsin, there are no laws preventing RWH but there are some rules that control what you can and cannot do with the collected water. There are several reasons why to harvest rainwater. It helps to save money on your water utility and sewer bill by your using less high-quality drinking water outside on lawns and plants.



It helps the environment by reducing storm water runoff to streams, rivers and lakes. It promotes conservation and reduces your overall carbon footprint. Harvesting rainwater provides people with intrinsic value as homeowners feel they are improving their community by creating a RWH system in their yard.

But there are also some disadvantages. RWH requires an initial investment in time and money to properly plan and design an effective system, which has an unknown payback period. It will also require some thought, and maintenance once it is up and running.

It is a common practice for homeowners to collect rainwater to use for outdoor purposes such as watering flowers, plants and grasses, washing vehicles or outdoor furniture, and watering private fruit and vegetable gardens. However, the water used for these purposes is subject to meeting certain quality water standards. This is where the Wisconsin Administrative Code, Department of Safety and Professional Services comes in. The rules and guidelines are buried in local and state plumbing codes and ordinances.

## LOCAL CITY AND STATE CODES/ORDINANCES

You do **NOT** need a permit to harvest rainwater in the City of Milwaukee provided your system a) does not have an underground collection tank, b) is not directly connected to the public water

supply, c) does not supply water inside your building, and d) is not used for potable applications. That means you cannot drink it, nor can you clean or cook food with it.



Wisconsin law does not specifically address water reuse the same way as other states but the Administrative Code Section 382 provides guidance on what we can and cannot do with harvested rainwater. Before we get into the details of rainwater harvesting, let's look at how some common terms used in the Wisconsin Administrative Code, here after referred to as 'the Code' are explained.

In Wisconsin, storm water is defined as ‘wastewater from a precipitation event’. Code Section SPS 382.34(3)(a)(1) states that *...storm water (and other wastewaters as approved by the department) may be reused in conformance with SPS 382.70*. In this context, the ‘department’ is the Department of Safety and Professional Services or SPS.

SPS Subchapter VII addresses Plumbing Treatment Standards, and SPS 382.70 establishes the treatment standards for plumbing systems that supply water to outlets based on the intended use.

Item (3) states that *...a plumbing system shall supply water that is of a quality that will protect public health and the waters of the state and be suitable for the intended use*.

Item (4) states that *...a plumbing system shall supply a quality of water at the outlet or at the termination of the plumbing system that meets or exceeds the minimum requirements as specified in Table 382.70-1*.

For reference, the identified Table 382.70 outlining the requirement is recreated at the end of this document, and is hereafter referred to as Table 1.

Section 381.176 defines plumbing. According to SPS 381.176.b.1 & 2, ‘plumbing’ does not include a rainwater gutter or downspout down to the point that it discharges into a plumbing system, subsoil drain, or a foundation drain. Furthermore, ‘plumbing’ does not include a process water reuse system (provided) the process water

reuse system is not connected to any plumbing fixture or appliance. Therefore, a rainwater harvesting system is *not* considered plumbing nor a plumbing system and is *technically* not subject to the plumbing treatment standards of SPS 382-70. The SPS 382.70(4)(b) states that for an outlet other than a plumbing fixture, appliance or appurtenance, there may be more stringent requirements by a municipality, governmental unit, state agency or owner of the plumbing system. However, as of August 2017, there are no other specific requirements that relate to a residential rainwater harvesting system.

With all that said, it is a good idea to respect the spirit of the law and show intent to follow the requirements of Table 382.70-1 for your RWH system on the chance that a plumbing inspector or city, county or state official decides to inspect your system. The remainder of this document will help you do just that.



So, let’s put that behind us and move on with the handshake-agreement that a rain water harvesting system *should* provide water meeting the minimum requirements of Table 1 (equivalent to Table 382.70-1). Let us focus specifically on intended uses #8 and #9 of the table as those relate specifically to storm water.

## INTENDED USE

If you want to use collected rainwater for '*subsurface infiltration and irrigation*' the system should be capable of providing water with less than a certain amount of oil and grease, and less than a certain amount of total suspended solids (TSS).

If you want to use collected rainwater for '*surface or spray irrigation*' the system should be capable of providing water with less than a certain amount of biochemical or biological oxygen demand (BOD), and less than a certain amount of TSS. Both TSS and BOD are defined later in this document.

Why the difference? The state of Wisconsin is obligated to protect public health. The state wants sprayed water to have fewer dissolved solids in it, which makes sense because sprayed water evaporates quicker and may introduce the suspended solids to the atmosphere, which people could breathe in.

## PLANNING

The planning process for establishing an RWH system can be complicated, but homeowners can get started quickly with just two pieces of information: supply and demand. What will be the volume of water supplied by the system over a period of time, and how much is needed to support their intended use over that same period

of time. These answers will help define the size, and location of the system.

## ESTIMATE SUPPLY

To illustrate this, we will describe a local family's journey. Dina and Eric have decided to install a rainwater harvesting system at their home. The first thing they did was estimate how much water they would collect each time it rained. They looked at their house and roof and found out what sections of roof drain to certain downspouts. Then they measured the area of each roof section feeding the downspout nearest to where they want the barrel to go and determined it to be 1000 square feet.

For every square foot of roof area, multiplied by the rainfall amount divided by 12 they know how much volume of water they would collect (in cubic feet). For example, in Milwaukee, Wisconsin with an average monthly rainfall of 2.9 inches, a 1000 ft<sup>2</sup> catchment area could collect up to 240 cubic feet (or 1800 gallons) per month. This would be the potential supply of the system.

Just to put this into perspective; with a rain rate of 0.25 in/hour (inches per hour) falling onto the same 1000 ft<sup>2</sup> catchment area, a 55-gallon barrel would fill in approximately 20 minutes. Table 2 provides rainfall information from the American Rainwater Catchment Systems Association (ARCSA) Standard 63: Rainwater Catchment Systems, which is a valuable resource for RWH planning and installation.

A more precise way to determine supply would be to use the following equation:

$$V = L (ft) \times W (ft) \times H (in) \frac{1 (ft)}{12 (in)} \times 7.48 \left( \frac{gal}{ft^3} \right) \times C$$

$$= \text{_____ gallons}$$

Where L = roof section length in feet, W = roof section width in feet, H = rainfall in inches, and C is a runoff coefficient for specific roof materials, see Table 3.

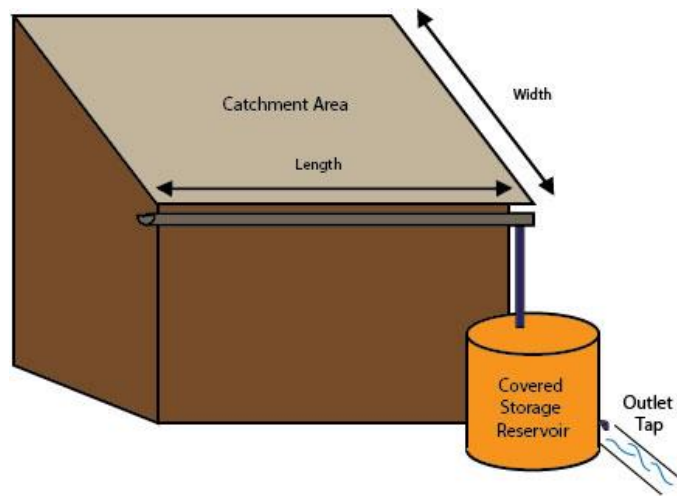


FIGURE 1 CATCHMENT AREA

## ESTIMATE DEMAND

Last summer Dina and Eric installed a small flow meter on their outdoor hose to measure how much water they used on their lawn, flowers, and gardens. During the growing season, they used an average of 400 gallons per month.

Another way they could have chosen to determine demand is by a review of past water bills. For most people indoor use is fairly consistent throughout the year, while outdoor use tends to increase during the growing season. Review your water bill account for the past several years, and chart the difference in water use from month-to-month. This will provide an indication of the additional monthly usage in the summer months. This extra consumption amount can be used to estimate the demand of outdoor non-potable use for sizing your system.

Be sure to determine demand in similar units as supply, volume per unit of time or gallons per month or week. There is an easy-to-use on-line calculator that can assist in determining demand also at

[www.home-water-works.org/](http://www.home-water-works.org/)

The amount of water used to irrigate landscaping, exterior flower beds, or gardens is typically greater than interior water use. Required irrigation water can be reduced by using 3 inches or more of top mulch, or by selecting native plant species or plants that thrive in a similar climate. Plant needs vary significantly depending on soil, climate, sun exposure and size. If a more accurate

determination of demands are needed, visit the websites identified at the end of this document for specific calculators.

## BUY the BARREL

Choosing and purchasing the rain barrel is part personal-choice but it is also guided by regulations. Knowing the local codes and selecting the right barrel size will help the RWH project serve the homeowner's purpose.

With an understanding of rainwater supply and demand of the system, Eric and Dina are now ready to size and buy a rain barrel. Although the material of the barrel is not critical, it should be opaque to block sunlight to reduce algae growth. **To comply with the City ordinance, the barrel must have a securely covered lid, be equipped with an inlet screen and have an overflow discharge device sized to adequately convey overflow.** The cross-sectional area of the overflow pipe should be the same area as the downspout feeding the barrel, usually a 3" PVC pipe will be adequate.

For more detailed requirements, see City of Milwaukee Department of Neighborhood Services, Plumbing and Sprinkler Inspection, in the Code of Ordinances. Volume 2, Chapter 225 Plumbing and Drainage.

Section 225-4 2.5-a.b.c defines *Rain Barrels as an above-ground prefabricated storage receptacle with an automatic overflow*

*diversion system that collects and stores storm water runoff from the roof of a structure that would have otherwise routed to a storm drain.*

Rain barrels are permitted in the City of Milwaukee provided the overflow conforms to the provisions of Section 225-4-2-a, *Roof Rainwater Leaders (Conductors), or is designed to overflow to a treatment drain or to a storm water conveyance system. Section 225-4-2-a states:*

*a-1. The point of discharge shall be a minimum of 2 feet from a basement or a foundation wall or alley property line and 5 feet from all other property lines.*

*a-2. The discharge shall flow parallel to or away from the nearest property line.*

*a-3. The discharge water shall not discharge to a street, alley or other public way.*

*a-4. The discharge water shall not create an icy condition on any pedestrian walkways within or adjacent to the subject premises lot lines.*

*a-5. The downspout hub (if present) shall be sealed with a 1" concrete cap or in a manner approved by the commissioner.*





Fifty-five gallon (24" diameter x 36" tall) rain barrels are available from Milwaukee Metropolitan Sewerage District (MMSD) and even includes a kit with an outlet connection and a downspout diverter. The MMSD website also has videos on how to assemble and install the rain barrels.

<http://www.mmsd.com/rainbarrels/rain-barrels>

Rain barrels shall/must be securely covered, include an inlet screen, have an overflow discharge sized to adequately convey overflow to the point of discharge and have a convenient and functional means of water withdrawal.

Dina and Eric decided that they wanted a one-week supply of water storage on hand. Since they use 400 gallons per month, one week would be 100 gallons, or two 55-gallon barrels. They bought two barrels and linked them together with bulkhead fittings and a flexible tube so the water level would be the same in each barrel. They also needed an inlet screen to prevent leaves and other debris from getting into the barrel.

## PLACE the BARREL

Once the rain barrel(s) have been purchased the location and placement are critical for safety and use.

Dina and Eric chose to locate the barrel in the back yard, directly under a downspout where they could then deliver the water to all of



their lawn and flower beds with the use of a 50-foot garden hose. They had to prepare the site where their barrels were installed by compacting and leveling the surface. Because a 55-gallon barrel full of water weighs 458 pounds, they wanted to be sure the barrel will not settle or shift. It is also a good idea to secure the tank to the house or some other rigid structure.

The barrel should be located near the point of use, but also near the supply line or downspout to minimize the amount of piping to and from the barrel. Think about both where you intend to use the water you collect, as well as where the water is coming from when you decide where to locate the barrel.

## FILL the BARREL

Once the barrels are properly located and equipped with inlet, outlet, and overflow drains, it is time for the rain barrels to collect rainwater and fill up. What is allowed to go into the barrels is dictated by the Wisconsin Administrative Code. Understanding the various types of water is critical to proper use of the system as well as protecting public health.

Dina and Eric are now ready to fill their rain barrels. They can only fill the barrels with captured storm water, or potable water. Remember that in Wisconsin, storm water is defined as ‘*wastewater from a precipitation event*’. This is a good time to explain what the other types of water classifications are as defined by the state.



Other classifications of water are defined in the Wisconsin Administrative Code and are not to be captured in rain barrels.

- **Wastewater** means clear water, storm water, domestic wastewater, industrial wastewater, sewage or any combination of these. *This is a broad term that commonly refers to water that has been previously used for a beneficial purpose.*
- **Clearwater** means wastewater OTHER than storm water having no impurities or where impurities are below a minimum concentration considered harmful by the department (Department of Safety and Professional Services), including but not limited to noncontact cooling water and condensate drainage from refrigeration compressors and air conditioning equipment, drainage of water used for equipment chilling purposes and cooled condensate from steam heating systems or other equipment. *This is basically waste water that is clean enough to use for purposes other than drinking or cooking.*
- **Domestic wastewater** means the type of wastewater, not including storm water, normally discharged from, or similar to that discharged from plumbing fixtures, appliances and devices including, but not limited to sanitary, bath, laundry, dishwashing, garbage disposal and cleaning wastewaters. *This is water that has been used in your home and is conveyed to the sewer system.*
- **Sewage** means wastewater containing fecal coliform bacteria exceeding 200 colony-forming units (CFU) per

100ml. *Sewage is a specific subset of wastewater that either has or is suspected of having fecal coliform bacteria (feces).*

- **Groundwater** means any waters of the state as defined in Section 281.01 (18), occurring in a saturated subsurface geological formation of rock or soil. *This is basically water that is underground and must be pumped out of the ground prior to use.*
- **Graywater** means wastewater contaminated by waste materials, exclusive of urine, feces or industrial waste, (which is normally) deposited into plumbing drain systems. *Greywater is essentially wastewater from your home's (kitchen, sink and wash machine / dishwasher) drains, other than the toilet – although it all drains to the same system.*
- **Surface water** means those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, all lakes, bays, rivers, streams, springs, ponds, impounding reservoirs, marshes, water courses, drainage systems, and other surface water, natural or artificial, public or private within the state or under its jurisdiction, except those waters which are entirely confined and completely retained upon the property of a facility. *Consider surface water any body of water that you could float a canoe on with the weight of one person inside.*

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**Potable water** is water that is both safe for drinking, personal or culinary use, AND free from impurities present in amounts sufficient to cause disease or harmful physiological effects. Potable water can be stored in the rain barrel and is often used to fill the barrel between rain events.

## USE the WATER in the BARREL

Now that the storm water is being captured and the rain barrels are filling or full, the homeowner can utilize the water for their needs. There are three typical methods for use: drip, spray or underground delivery.

Before the system is used, you will need to determine how you will get the water from the barrel to the point of use. The easiest and least expensive way is to use gravity and a hose. If you find that you do not have adequate flow or pressure from gravity alone, you can consider installing a pump. Choosing a pump quickly becomes a complicated process and is beyond the scope of this document. However, knowing that a typical garden hose connected to city water flows up to 5 gpm (gallons per minute) with a supply pressure of 35 psi (pounds per square inch), your RWH system will likely not attain these values unless a pump is installed, so don't expect the water to flow like it does from a conventional spigot.

Dina and Eric plan to use their harvested rainwater for surface irrigation through watering cans, soaker hoses and spray irrigation with sprinklers. This provides an easy means to get the water to the point of use. They initially chose a gravity feed system to avoid investing in a pump, but it can always be added later.

Remember, if you want to use collected rainwater for '*surface or spray irrigation*' it means delivering water to the surface of land or

crops via pipes, perforated hoses or spraying through a nozzle or sprinkler. Your system should be capable of providing water with less than 10 mg/L of biochemical/biological oxygen demand (BOD), and less than or equal to 5 mg/L of total suspended solids (TSS). See intended use #9 in Table 1.



If you want to use collected rainwater for '*subsurface infiltration and irrigation*' it means delivering water via underground beds, basins, pipes or hoses beneath landscaped or paved surfaces. Your system should be capable of providing water with less than 15 mg/L of oil and grease, and less than or equal to 60 mg/L of TSS. See intended use #8 in Table 1.

The issue of the protection of public health is addressed within the code to assure foreign solids (TSS) and organics (BOD) do not

contaminate the watered areas nor the people in or near those areas. No one wants to be responsible for someone else's sickness caused by exposure to potentially contaminated rainwater.

## TSS and BOD DEFINED

**TSS** is *total suspended solids*, or the dry weight of particles trapped by a filter, which typically means particles larger than 10 microns. These solids include anything drifting or floating in the water, from sediment, silt and sand to algae. Total suspended solids are a significant factor in observing water clarity. The more solids present in the water, the less clear the water. The key here is word *suspended*, since larger heavier particles settle to the bottom of the tank, but smaller lighter particles remain suspended.

TSS is expressed as a concentration, as a mass per unit volume. For every 1 liter of water, you must have less than 60mg of solids suspended in the water. So, if you were to take 1 L of water from the tank, filter it and evaporate all of the water you would need to have less than 60 mg of solid material left. For reference, a typical kernel of popcorn could weigh 60 mg, and an average rain drop weighs 30 mg. The easiest way to obtain this is to remove water out of the barrel from an elevation above the sediment layer in the tank, and/or use a filter. Placing your supply line 4 inches above the bottom of the tank will ensure that you are removing relatively clear water from the barrel. See Pro Tip #6.

**BOD<sub>5</sub> (or simply, BOD)** is *biochemical oxygen demand* (or biological oxygen demand) It is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at a certain temperature over a specific time period. This is not a precise quantitative test, although it is widely used as an indication of the organic quality of water. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of water sample during 5 days of incubation at 20°C and is often used as a robust surrogate of the degree of organic pollution of water.

BOD is also presented as a concentration of mass per unit volume, but it represents the amount of organic pollution present in the water. It is neither easy nor economical to test a residential or small-scale commercial property's RWH system for BOD. A better solution is to prevent the organic material from entering the tank. The use of first flush diverters, screen filters, or cyclone filters, greatly reduces the amount of organic material that enters the cistern or tank. See section below and Pro Tip #2.

An activated carbon filter can help remove organic materials that may be present in the tank water. As water passes through an activated carbon filter, organic particles and chemicals are trapped within pores of the carbon media. There are many factors that impact the effectiveness of activated carbon filtration and this beyond the scope of this document.

To comply with the current codes, you should technically use two filters. The first should be a particulate filter to remove suspended



solids, and the second should be an activated carbon filter to remove organics or BOD. If you do choose to use a filter use a two cartridge housing. This way you can replace the cartridges easily and change the different cartridge types to suit your needs. Choose one with a clear housing so you can see when the filter cartridge becomes fouled.

For most homeowners, these filtration requirements might be seen as prohibitive and unnecessary -- they just want to water their lawns and flowers. This is one area where changes to the code might be recommended to encourage the practice of rainwater harvesting. Other states and municipalities do not have treatment requirements for collected rainwater that is used exclusively outdoors for non-potable applications. But many of these states require pre-treatment devices to ensure that debris and organic materials are not allowed to enter the barrel.



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Under certain circumstances, harvested rainwater can be plumbed into the house and connected to fixtures supplying water to your toilets. Although this type of system requires specific approval from the City of Milwaukee, there are cases of its effective use. **Collected rainwater should not be brought into the home for reasons other than watering plants, unless you have a permit from the City.** The primary concern is the protection of Public Health. There is a potential for contamination of the city's drinking water supply if contaminated rainwater were to enter the distribution system.

As the use of collected storm water becomes more practical from an economic as well as from an installation and operation point of view, more water harvesting projects will begin. There are ways to properly deliver collected and treated rainwater into the home and connect to select fixtures such as toilets, but it is beyond the scope this document.

Wisconsin students, university faculty, city officials and regulators are discussing potential changes to the Wisconsin plumbing code that may allow this practice and provide further guidance for residents and property owners to employ this practice within their properties. In fact, there are a few locations within the city that use collected rainwater in the water closets. The Urban Ecology Center and the Clock Shadow building are examples but both are operating under specific conditions and sampling programs, or are using a proven disinfection process.

## PRO TIPS

This section will discuss ways to enhance your system, impress your friends, and learn from others who have experience with RWH systems. These pro tips will make the collection, storage and delivery of storm water easier and more effective for the homeowner.

1. Safety First. ALWAYS consider the safety of yourself, other people/animals and your property when installing equipment in your home or on your property. Always follow equipment manufacturer's instructions for installation and maintenance.
2. Install a first-flush diverter in the downspout to remove contaminants before they enter the barrel. The first few gallons that come off the roof are likely contaminated with bird droppings, insects, particulates and even chemicals that leach out of the roofing materials. Try to collect 10-15 gallons of water for every 1000 square feet of roof area for each rainfall event. Doing so will help you maintain higher quality water in the barrel.
3. Install an in-line downspout screen filter to keep the leaves and large debris out of the barrel. Leaves and insects are sources of BOD, keep them out of the tank. An in-line downspout filter can be used in place of tank top screen.
4. The location and material of the container matters. You want it to provide enough water to the right location for your needs and it should block sunlight. High density polyethylene (HDPE) is recommended and readily available. The barrels from MMSD are likely HDPE.
5. Keep your storage capacity below 360 gallons at one location. This will keep your system considered "small" in the view of ARCSA Standard 63. A larger storage volume may require treatment if the plumbing codes(s) are changed to adopt ARCSA Standard 63 or other comparable standards.
6. Consider the location of your barrel outlet, overflow, and drain before you cut the holes, and make it easy to clean and service. Put the primary-use outlet approximately 4" from the base so sediment can collect. Put a drain on the very bottom with a full port ball valve so the tank can be cleaned and all water/sediment can be drained for winterization. Put the overflow line near the top and rout the outlet piping in full accordance with the city ordinance.
7. Consider where you want to use the water and the head, or pressure loss through a hose. Put the container on an elevated base. Every foot above the ground increases available head pressure by 0.43 psi. It is recommended that the tank be 1-2 feet above grade. Keep it close to the house near a downspout.
8. Choose a cartridge filter with a bypass line. This way if your filters are clogged you can bypass the filter for a short period of time while you service them.

9. Link the barrels with tubing and the level will be the same in each barrel. Do not connect more than 6 tanks together or the volume will exceed 360 gallons and additional requirements may be imposed.
10. Test kits can be purchased for testing harvested water. Several companies make kits that will test everything from clarity to pH. If you want to know the specific quality of the water in your barrel – there is a test kit available for it.
11. Provide a way to fill your barrel with city water. This may sound counter-productive, but more progressive states require a potable water make-up connection with an air gap or approved backflow prevention device.
12. Install a meter. Brag to your friends and neighbors about how much water you've collected and used. Who knows someday the water utility may give credit for water that is not sent to the sewer, provided you can document the amount.

The American Rainwater Catchment Systems Association (ARCSA) Standard 63: Rainwater Catchment Systems, is a valuable resource for RWH planning and installation. This document is an ANSI approved standard that was written in conjunction with American Society of Plumbing Engineers (ASPE). It is available for purchase from many on-line sources. It provides much more detailed information for both potable and non-potable water applications.



## LINKS FOR MORE INFORMATION

**Wisconsin Administrative Code**

[https://docs.legis.wisconsin.gov/code/admin\\_code](https://docs.legis.wisconsin.gov/code/admin_code)

**City of Milwaukee Ordinances**

[www.city.milwaukee.gov/cityclerk/ordinances#.WH0FQBsrKUk](http://www.city.milwaukee.gov/cityclerk/ordinances#.WH0FQBsrKUk)

**Milwaukee Water Works** [www.city.milwaukee.gov/water](http://www.city.milwaukee.gov/water)

**Milwaukee Metropolitan Sewerage District** [www.mmsd.com](http://www.mmsd.com)

**ReFresh Milwaukee** [www.refreshmke.com](http://www.refreshmke.com)

**FreshCoast740** [www.freshcoast740.com](http://www.freshcoast740.com)

**ARCSA** [www.arcsa.org](http://www.arcsa.org)

**HarvestH2o** [www.harvesth2o.com](http://www.harvesth2o.com)

**ReFlo** [www.refloH2o.com](http://www.refloH2o.com)

**Stormwater Solutions Engineering LLC**

[www.stormwater-solutions-engineering.com](http://www.stormwater-solutions-engineering.com)

For additional information contact the City of Milwaukee Environmental Collaboration Office at 414.286.8556.





## THE FUTURE OF BARRELS

What starts with Dina and Eric wanting to collect rain and water their tomatoes to what the city and state could do just a matter of scale. Investigating the Urban Ecology Center at Riverside Park shows where the State of Wisconsin and the City of Milwaukee can be working towards in the future of rain water harvesting.



### Case Study – The Urban Ecology Center at Riverside Park.

The UEC Riverside Park's rainwater collection system covers 50% of their toilet flushing needs and helps conserve 100,000 gallons of

potable water per year. The system uses a 3100 square foot south facing roof as the catchment area. The conveyance system is a metal gutter that flows to the east. A cyclone filter and filtering drain provide pre-treatment of debris. A diverter valve is used to direct the rainwater to either the exterior rain barrels or in the interior cisterns. Their three 350-gallon water cisterns collect rainwater that falls on the roof and stores it for use. The system is fitted with a potable water make-up line. The three tanks are in series but are each isolatable in case one needs maintenance the others can still be in use. The system operates automatically using level switches and a pressure sensor. The tanks drain to a common header where water is circulated with a pump and treated with chlorine and pH-adjusting media as needed. The tanks also feed a lead/lag pump system with a pressure tank that provides the necessary pressure to operate the water closets and urinals of the facility. There is a water meter on the potable water make-up/supply line and another between the cistern and the pump skid. By subtracting the value of meter 1 from meter 2 the site can determine the amount of rainwater used. The site also uses dual flush low flow toilets and urinals. Referring to Table 1, this use requires specific treatment standards for pH, BOD, TSS and chlorine residual. The UEC Riverside meets these requirements and samples their water on a regular basis.

With each change in scale however, new concerns for the protection of public health will need to be addressed. The system described

above is an example of intended use #11 from Table 1. You will notice that there are more treatment standards since the potential for human contact are greater.

### pH

The pH of water is not a physical parameter that can be measured as a concentration or in a quantity. Instead, it is a value between 0 and 14 defining how acidic or basic a body of water is. The lower the number, the more acidic the water is. The higher the number, the more basic it is. A pH of 7 is considered neutral. It is presented on a logarithmic scale which means that each number below 7 is 10 times more acidic than the previous number when counting down. Likewise, when counting up above 7, each number is 10 times more basic than the previous number.

### Free chlorine residual

A chlorine residual is a low level of chlorine remaining in water after its initial application. It provides an important safeguard against the risk of microbial contamination after initial treatment - unique and significant benefit for public health. The presence of free residual chlorine in drinking water is directly related to the absence of disease-causing organisms, and is therefore used as a measure of the potability of water. When chlorine is added to water, some of the chlorine reacts first with organic materials and metals in the water. This chlorine is then not available for disinfection. This is called the chlorine demand of the water. The remaining chlorine concentration after the initial chlorine demand is consumed is called total chlorine. Total chlorine is further divided into: 1) the amount of chlorine that has reacted with chemicals and is unavailable for

disinfection which is called combined chlorine and, 2) the free chlorine, which is the chlorine available to inactivate disease-causing organisms.

## CONCLUSION

In this document we have defined what rain water harvesting is, and some of the key elements of an effective rain water harvesting system. The local City and State ordinances related to RWH, rain barrels, plumbing and water quality have been identified and two case studies were presented. Guidance and a methodology for planning, installing and using a rainwater harvesting system have also been provided. Additionally, reasons to invest in and use rainwater for non-potable outdoor uses have been identified.

Hopefully you are inspired to seek that intrinsic value and pride of knowing that your efforts to reduce consumption of high-quality treated water and increased use of free rainwater for applications that do not need high quality drinking water. In addition, you may recognize reduced water and sewer utility bills, which is beneficial. So go buy a barrel, locate that barrel, fill the barrel with rainwater and use that rainwater outdoors on your lawn and garden. And remember, every drop counts.



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**Table 1. Intended use and treatment standards, recreated from Wisconsin Administrative Code SPS 382.70-1.**

INTENDED USE	TREATMENT STANDARDS	METHOD TO TREAT
Intended uses 1-6 are not included in this table.		
7. Subsurface infiltration and irrigation using reuse as the source.	<15 mg/L oil and grease ≤ 30 mg/L BOD <sub>5</sub> ≤35 mg/L TSS < 200 fecal coliform CFU/100 mL	Not applicable.
8. Subsurface infiltration and irrigation using <b>storm water</b> as the source.	<15 mg/L oil and grease ≤60 mg/L TSS	(No action) Install filter
9. Surface or spray irrigation using <b>storm water</b> and <b>clear water</b> as the source.	≤ 10 mg/L BOD <sub>5</sub> ≤5 mg/L TSS	Install pre-filter Install filter

10. Surface irrigation <u>except</u> food crops, vehicle washing, clothes washing, air conditioning, soil com-paction, dust control, washing aggregate and making concrete.	pH 6-9 ≤ 10 mg/L BOD <sub>5</sub> ≤5 mg/L TSS Free chlorine residual 1.0-10.0 mg/L	pH control Install pre-filter Install filter Add/test for chlorine
11. Toilet and urinal flushing.	pH 6-9 200 mg/L BOD <sub>5</sub> ≤5 mg/L TSS Free chlorine residual 1.0-4.0 mg/L	pH control Install pre-filter Install filter Add/test for chlorine



**Table 2. Average Monthly and Total annual rainfall for Milwaukee, WI (inches).**

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total	AVG
Milwaukee	1.9	1.7	2.6	3.8	3.1	3.6	3.6	4.0	3.3	2.5	2.7	2.2	34.8	2.92

Obtained from ARCSA Standard 63.

**Table 3. Runoff coefficient for different roof types.**

	Asphalt & Fiberglass Shingles	Concrete Tiles	Terra Cotta	Aluminum	Wood
Factor C	0.90	0.85	0.7	0.9	0.65

Obtained from Arizona Rainwater Guide (2006) and ARCSA Standard 63.



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